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ABSTRACT

This paper comprises analysis and design components of a program of studies to assess the impact of the federally funded program of research and development centers in education. Opening with an introduction and comments on design considerations, the paper analyzes four systems that taken together, with their mutual interfaces, describe the domain of impact. The systems are those of knowledge production, knowledge distribution, knowledge implementation, and knowledge use. Eight aspects of analysis are proposed with reference to each of these systems. The penultimate section brings together previously mentioned notions on the methods of assessment, outlining specific studies to be carried out. A final section of conclusions emphasizes again the comprehensive nature of the design proposed and makes a suggestion in regard to desirable research personnel. (Author)

The Impact of the Federal Research and Development Center Program on American Education

A Problem Analysis and Design Paper for a Program of Studies

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1. INTRODUCTION

1.1 The Task of the Paper

In this paper we outline a framework for a program of studies to assess the impact of the Federally funded Research and Development Center program on American education. Such an assessment is a task of great magnitude. Inevitably, it will necessitate several separate investigations conducted by different investigators. These studies must both logically relate to one another as well as yield a comprehensive picture of the impact of this major aspect of Federal science and education policy. This preliminary problem analysis and design paper can be the groundwork for assuring such coherence and comprehensibility. We present, therefore, an analysis of the scope of the problem and make suggestions for research approaches; we describe a strategy for a research program, but we do not offer designs for the component studies.

1.2 Approach

Assessing the impact of a major and complex policy like the Research and Development Center Program (which includes both the Research and Development Centers and the Regional Laboratories), is a difficult and important undertaking. Neither science nor education policies are known as areas that lend themselves to easy evaluation by direct inspection. The Research and Development Center Program is particularly complex because its introduction coincided, and possibly caused, a major

restructuring of organizations and priorities in the field of educational research. Therefore, the plan to measure the impact of Federally financed, disciplined research and development on education requires some systematic reflection on the major domains which were affected by the policy, and on the criteria by which they are to be assessed.

The Federal policy modified an already existing and extremely complex set of nationwide and local arrangements for the production, distribution, implementation, and use of educational knowledge.[1] It would be misleading to measure the merits of the effort merely by measuring direct effects on school practice, as they are presently obtained in the field. Because of the complexity of the systems for knowledge production, distribution, implementation, and use in American society, systematic leads and lags must be anticipated as innovations are spread through the system, and major impacts may be of the unanticipated variety.

In this design paper we, therefore, follow a systemic approach to impact assessment. Premature commitments to simple indicators should be avoided. For example, measuring impact and effectiveness only through adoption rates of products, or measurement of the cost of adopted products, may not only be misleading but also may have the harmful effect of pressing for short range results even in situations that demand long range solutions.

The perspective in terms of which the design paper is written is, then, entirely consonant with the approach taken by the staff of the National Institute of Education in their December 1973 report on knowledge production and utilization in education,[2] and with the rather comprehensive view taken in the earlier study prepared by the Bureau of Research in the

Office of Education,[3] which presented to the Organization for Economic Cooperation and Development a report on educational research and development policies in the United States.

1.3 Utilizability; Relation to System Monitoring

The design of the plan to assess the impact of the research and development system should be such that the impact study itself can become the basis for a longer range program of monitoring the system's performance. In the specific design efforts of component studies it will be necessary to investigate alternative impact indicators. It may be an economical procedure to use this work as the base for a program of system monitoring in which these indicators would be periodically assessed. The initial design procedures must therefore be flexible, and must allow for inputs both from the potential users and the producers of the information to be used in the monitoring program. We attempt to make provisions for such flexibility and usability.

The execution of the impact studies program is a large enterprise. A design consideration for which we are in no position to make specific recommendations, but which should be weighed, concerns the timing of impact studies in relation to the timing of policy decisions to be made in the Institute. The development of an integrated schedule may facilitate both the conduct and the utilization of the research.

2. DESIGN CONSIDERATIONS: IMPACT DOMAINS AND IMPACT PATTERNS

2.1 Introduction: Policy Goals

The Research and Development Center Program was established, approximately ten years ago, in order to speed the process of generating and applying scientific knowledge to education for the purpose of improving instructional practice and programs.[4] This policy was the second phase of major Federal research support for educational innovation and knowledge production; the earlier phase of grant support for individual projects was initiated approximately twenty years ago. It would appear that the decision to adopt the Research and Development Center Program policy was based on the following considerations: it was felt that the earlier pattern of supporting and coordinating educational research through individual grants did not lead to an adequate concentration of resources and talent for the kinds of sustained effort that could reasonably be expected to produce cumulative and conclusive results. Project research had remained small and fragmentary; there existed a large gap between research and practice; the field of educational research did not attract leading social and behavioral scientists; and there appeared to be a lag between basic social and behavioral science theory and methodology and the field of educational research.[5]

The Research and Development Center Program thus was a policy conceived to overcome these problems by supplementing small scale efforts with large programs of interconnected research and development. The strategy to assemble a "critical mass" of research scientists who would

direct their efforts towards applied research and development of educationally useful products was not just intended to produce specific innovations but also to impact the field of educational research by providing structure, leadership, and new models and standards of judgment.[6] The policy is an ambitious one; it is designed to impact the entire system of educational knowledge production and use in a strategic manner.

The key conceptions in this enterprise appeared to be the notions of scientifically disciplined research and development, and of scientifically grounded, codified professional practice in schools. The assumption is that only scientifically disciplined research leads to cumulative knowledge and the detection and correction of errors; scientifically grounded, and disciplined practice would be necessary to improve the performance of schools.[7] Since the program has such broad policy objectives, it is reasonable to measure its impact over several domains. Considerations concerning the availability and mobilization of manpower, the development of organizational structures, and management systems, the scientific stock of knowledge, technologies and procedures, and standards of professional practice need to be considered across the target domains.

2.2 Impact Domains

Four empirically and analytically distinct domains can be distinguished in any large scale, institutionalized system utilizing scientific knowledge for the improvement of professional practice. They are the systems of knowledge production, of knowledge distribution, of knowledge implementation, and of knowledge utilization or use, in ongoing activities.

It is fairly clear that the dynamics of knowledge production in research establishments and elsewhere differ sharply from the processes of knowledge distribution through markets or organizational channels. This distinction has been well recognized.[8] However, it is less often recognized that the domain of implementation of programs based on new knowledge differs both from the knowledge distribution and use of systems. A brief remark concerning our insistence to deal with implementation as a distinguishable system may be necessary. Implementing a new process almost always leads to an at least initial increase in complexity, and in higher demands on time and effort of staff, and thus to organizational overloads. Since such episodes of implementation occur with some regularity in knowledge utilization systems, there develop more or less institutionalized arrangements for dealing with these problematics. The "implementation system" includes those organizational arrangements and aspects of institutions which offer supports of various kinds, such as funds, personnel, advice, to reduce the temporary overload and facilitate the routinization of innovations into the use system

The "use system" refers to codified, professional practices in ongoing operations, into which new knowledge or programs have become incorporated.

2.3 Impact Patterns and Criteria

We distinguish between different patterns of impact which may be traced through alternative approaches. In principle it appears straightforward to assess the impact of any given Research and Development Center by locating instances of adoption of their products (and such, empirically

quite complex, work certainly needs to be done). However, this approach would not in itself assess the impact of the policy to promote the Research and Development Center movements in terms of strategic significance for the structuring of the field of educational research knowledge and application. The former problem requires studies of product distribution and use, which should be conducted both by tracing the distribution of innovations from their source to the site of use, and in the reverse direction. The latter problem requires an assessment of the organization of the field, the effect on manpower supplies and mobilization, and the relationship between R & D center priorities and those in the field generally. A major issue in this regard is the spread of the standards associated with disciplined research and development through America's educational institutions. The search for such an impact pattern certainly will require an approach somewhat different from a study of product diffusion.

We therefore propose that studies be done in the four impact domains (knowledge production, distribution, implementation, use), in their linkages with each other, tracing impact patterns both from the knowledge production sector to the domain of utilization, and from operating school systems to the source.

These complementary approaches will shed light on the relative significance of the knowledge produced in the Research and Development system in relation to the total volume of knowledge used; they must be supplemented by the study of the scientific movement spearheaded by the Research and Development Centers and its impact on the total field. It is in this latter area that strategically important, long range impacts may be developing.

The question of which effects are to be considered significant impacts, and how they ought to be causally attributed to the policy is to be treated in the specific design phase of each study; we limit ourselves in the following to outlining the process in which specific determinations of impact criteria and attributions appear in principle feasible, and we make some suggestions in this direction; we are guided in this by the stated objectives of the policy as they are discussed above.

In the next sections we outline the issues to be studied in relation to each impact domain and linkage area; this is followed by a section outlining a system of interlocking studies to obtain this information.

3. THE KNOWLEDGE PRODUCTION SYSTEM

3.1 Major Questions

The central issues with regard to the knowledge production system are simply:

-- What is the position and relative significance of the R & D Centers' programs in the total educational knowledge system?

-- In what ways have the Research and Development Centers' programs changed the production of educational knowledge?

-- What are the consequences of these changes?

The treatment of these issues requires a combination of historical and sociology of science approaches. Historical reconstruction will not be difficult since several good studies of the state of affairs in the early sixties are available and may serve as a base line.[9] However, it appears to us that many of the issues outlined in systematic overview fashion below have not been raised and that therefore new information gathering activities will be necessary.

3.2 Mapping the Domain and its Structure

Obviously, the Research and Development Center Program does not exhaust the domain of educational knowledge production in the United States. A current overview of organizations engaged in educational research may, for a first orientation, be derived from an analysis of available organizational directories.[10] The major types are: the university based research and development centers; other university based educational research institutes; the Regional Laboratories; non-profit

research establishments like the American Institutes for Research; profit making research corporations; publishing houses; research bureaus in state departments of education, in large school districts, and so on. Trends in these organizational patterns over the ten year period of the R & D policy can be established and measures of relative productivity may be provided. These trends may or may not reveal the realignment of organizational patterns in response to the establishment of the Research and Development Centers.

Particularly significant patterns of such knowledge producing organizations may be identified for more detailed review with the objective of determining their relative significance and location in the total system. For example, the large non-profit institutes have made well known contributions of major significance;[11] any review of the organizational structure of the field would have to pay particular attention to this factor.

Yet, educational knowledge is not only produced in the organizations deliberately designed for this purpose. It is also created in social movements, in public debates, through literary efforts, and through local innovations by expert practitioners.[12] Much of this "knowledge" is not being presented in the model of scientifically rigorous research and development; but any inspection of the American educational scene reveals that such political and intellectual trends, local innovations, the efforts of activist groups and the like have a major impact. In fact, it is not a settled question whether the implementation and use systems are more affected by this sector or by the formal organizations of professional education research. In order to map the total system it is important, no matter how difficult, to arrive at an estimation of the scope, structure,

and direction of these activities to permit a look at the relationship between federally sponsored and formal and other knowledge production. Interview, or assessment symposia, with highly informed and articulate persons may be one avenue for an economically feasible approach to the problem. Education editors of major newspapers and magazines come to mind in this connection.

3.3 Standards

The leadership of the Research and Development Centers can be considered a movement for reform in science and educational practice. They advocate a standard of "rigor" in applying scientific concepts and methods in education which appears to give the work and possible impact of these organizations a particular quality and direction. For example, it is demanded that innovations in education be designed following scientifically grounded principles, that they be pre-tested, systematically developed, and evaluated, and that under no circumstances are they to be simply introduced on the strength of enthusiastic commitment.[13] This emphasis on fairly specific conceptions of standards differentiates this reform movement sharply from other efforts to improve contemporary American education, as for example in the "free schools." Similarly disciplined and professionally informed behavior is also expected of the teacher, whose "art," according to the research and development movement, is to be enhanced by a broad repertory of scientifically grounded tools.

Certainly, the movement to utilize behavioral science and to codify professional practice in education is not simply co-extensive with the Research and Development centers. However, there appears to exist

both affinity and a major overlap of personnel. It should not be difficult -- and it would be highly informative -- to gather evidence that has a bearing on these points. To do so would be helpful for impact assessment and policy formation since the successful propagation for standards of professional practice may have effects of a profound and far-reaching nature.

Empirical questions to be answered might include the following issues:

-- To what extent is there consensus among Research and Development Center leading personnel on standards of professional work and on what constitutes "disciplined research and development"?

-- To which sources and groups can the commitment to the standard be traced? Professional leaders of the field of educational research advocated the model of scientifically disciplined efforts well before the adoption of the policy by the government;[14] however, the emphasis was not uncontroversial. To what extent has the policy reinforced a circumscribed intellectual elite in their positions, and to what extent has there been an exercise of leadership by demonstrating to the field at large the need for the advocated standards and their superiority over alternative models?

-- What is the structure of the social networks among the research and development leadership and among the productive persons in the field of educational research in general? Of particular importance in this regard is not only to map the networks or "invisible" colleges, but also to assess the prestige structure and the position of the relevant individuals and groups within it. It is not recommended to use a study of prestige ratings

simply in order to determine "quality," as this might be quite misleading in a rapidly developing field, but to shed light on the direction of leadership and the persuasiveness of standards advocated.

-- Has there been an effect of the demand for rigorous standards on publications and other policies in the scholarly associations in the field of educational research, as demonstrated by the nature of review procedures, the composition of review panels, the structure of scholarly programs at meetings, and referral networks for personnel recruitment?

-- Have there been effects of these processes on the curricula of schools of education and of other graduate departments in related fields?

The question of whether a possibly detected change in the standards of the wider field of educational research and related disciplines can be attributed to the research and development centers may be tackled indirectly through mapping the position of research and development center personnel in the structure of social network and prestige structures among education researchers, in scholarly associations and organizations, and through investigating the history of diffusion of model standards for disciplined research and development.

3.4 Priorities

As in any scientific enterprise, priority setting for the knowledge production efforts of the Research and Development Centers is a complex process. The nature of this process, however, can be clarified by

investigating the frames of reference of research and development leaders, and the strategies they employ for the detection, priority assignment, and solution of problems. Problem detection, and the assignment of priorities in the distribution of efforts to tackle them, is, probably, the single most central process in knowledge production. The criteria and structure of assumptions involved in these processes is often implicit and unreflected leading investigators to the discovery of "interesting" or "fascinating" issues indirectly. However, the sources of such problem detection processes can be investigated by studying the structure of frames of reference, and the cognitive strategies for problem identification and solution. It is particularly important in understanding a research and development enterprise to provide knowledge about the sources of investigative problems chosen. These would include disciplinary paradigms and theories, concern with public issues or value conflicts, a commitment to problem solving in ongoing professional practice as well as other sources. It is to be expected that the professionalization and increasing complexity of the structure of the field of educational research may lead to a shift of the sources of investigative problems into the internal dynamics of the professional domain itself. As a consequence there may be a divergence from problem detection processes in operating educational systems and public debates. Such divergencies or convergencies may have subtle, but in the end, major effects on the acceptance of products, and indeed, of the research and development effort.

Specific priority setting mechanisms can be investigated by studying the reference frame of research and development leaders through detailed interviews, the analysis of their research strategies, the utilization of programmatic statements, and the relation of these findings

to the actual distribution of effort in the organizations. Comparative work with non-research development persons in the knowledge production and in the distribution, implementation and use domains is necessary.

The pattern of priority setting in the Research and Development Program may have changed over time. It is at least possible that in the early phases of the program priorities were assigned to projects expected to yield at least some visible results in a short time. It is further likely that monitoring and auditing procedures used by the government sponsors would and continue to have an effect on priority setting. It is important to discover these trends and the relationship between priority setting and governmental evaluation of the centers. Such information needs to be taken into account in designing the program monitoring of the Research and Development system in the future.

3.5 Stock of Knowledge

Educational research, including some of the work carried on in research and development centers, contributes to various bodies of knowledge for practicing educators, for educational research itself, and for certain scientific disciplines. An assessment of the structure of the stock of knowledge in use in the centers, their contributions to it, and their contributions to other fields would be required if one wishes to show their impact in this area. Both qualitative and quantitative approaches seem indicated.

Several "state of the art" assessments of the available stock of knowledge in educational research have been undertaken before, for example in annual reviews of educational psychology, in various presidential addresses before the American Educational Research Association and other

scholarly bodies, and on other occasions.[15] A major overview may well be fruitful at this time since many investigators are claiming the occurrence of a "paradigm shift" from behavioristic learning theory as the basic scientific foundation to cognitive psychology and social psychology.[16] Such work might be conducted, for example, by the National Academy of Education in analogy to their overview "Research for Tomorrow's Schools." A quantitative study of research production and of the network of citations may be helpful in locating the research and development centers within the knowledge production system and demonstrating their contribution to the working stock of knowledge of the field.

3.6 Products: Devices, Technologies, Procedures

Considerable emphasis has been placed on the assessment of Center productivity by measuring the effectiveness of their products and their distribution. For example, the review conducted by the Comptroller General of the United States and submitted to the House of Representatives and Senate in August 1973[17] measures the impact of the R & D centers almost entirely through a rather searching overview of production evaluations and marketing and dissemination strategies. In the impact research program recommended here, such efforts also are considered of major importance. However, as the foregoing has made clear, they ought to be imbedded in a strategy to map the total impact domains.

In order to trace Center products it will be necessary to construct a careful list of products and their characteristics. This may appear as a simple and straightforward task, but it is not. It is insufficient to review Center reports and cull from them the names of innovative programs

that have entered the dissemination process. Tracing the distribution of products by tracing the acquaintance with or utilization of their names is only a first, and superficial, approach. More appropriate is the detection of key tracer "tags" in the developed educational technologies and procedures so that actual practices might be identified. Such a list of products and their characteristics for the purpose of tagging traceable components requires detailed analysis of the matter by technically qualified personnel.

Estimates of product costs should be undertaken with due accounting for the costs of other desired impacts.

For each major product a degree of utilizability assessment might be made, including a review of the product's legal status (for example, in relation to copyright laws), and its relation to the standards, priorities, and theoretical principles of the field.

With this material provided, it is possible to construct a macro-analysis of the institutional channels for product distribution, implementation, and use through a survey of key personnel and the scrutiny of reports. It is not recommended to conduct such a study in great depth or in detail, but to supplement it by tracer studies following selected products from knowledge production through the system to use. Such tracer studies, taking as their point of departure the knowledge production sector in the Centers, should be supplemented by case studies described below in the distribution, implementation, and use systems. Such work will be facilitated by integrating the studies with the available evaluative studies of product effectiveness.

3.7 Organizational Structures and Nesting

Research and development in education has, over the period of the last decade, been groping for appropriate organizational and management models. An overview of alternative models for organizations that have been generated in the R & D Center Program, supplemented by in-depth case studies of selected centers, could be extremely helpful in improving leadership and management procedures, and in demonstrating whether the Centers have produced organizational innovations of their own.

The research and development centers are located in universities, but in different nestings. The differential impact of such nesting arrangements, for example in schools of education or in alternative locations in the university structure, would give initial data on the impact of the research and development centers on their host universities. Since their location in universities may affect the instructional practices of these institutions, this impact domain must not be neglected.

The regional laboratories, being of a different organizational design, may be expected to have evolved certain novel conceptions of their own in the area of organizational structure and management procedures. A similar approach of a broad survey and specific case studies could be followed for both types of organizations.

It should be noted that the study of problems mentioned earlier in relation to the effect of the research and development program on scientific fields and their scholarly associations would shed light on the organizational impact of the center program on these fields.

3.8 Manpower

The availability of highly qualified manpower for educational research and development has been a problem for some time. It can be expected that the existence of research and development centers and the educational regional laboratories has had a major effect on the situation in this area. An investigation of the effect of these organizations on the structure of channels for social mobility of persons entering careers in behavioral and social science and educational research is much needed. It is therefore recommended to supplement quantitative assessments of the available manpower pool in the relevant training areas by studies of career channels and patterns, including studies of career aspirations of graduate students. It may also be the case that the necessity of recruiting personnel for research and development work from schools and school administrations and other professional domains may significantly impact the career patterns of these persons and thus have an effect on the manpower pool available for educational innovation more generally. Estimates in this domain would require investigations of subsequent career experiences of persons who for a time worked in R & D Centers or Regional Laboratories, and the effects that can be attributed to their work in the program.

4. THE KNOWLEDGE DISTRIBUTION SYSTEM

4.1 Major Questions

The main concerns with the knowledge distribution system in education are:

-- What is the position of the research and development centers and educational laboratories in relation to the total educational knowledge distribution system?

-- How effectively are research and development knowledge products disseminated?

-- What are the filtering effects of the system, what are its conductivity characteristics?

-- In what ways have the research and development center program and the laboratories impacted the educational knowledge distribution system itself?

4.2 Mapping the Domain and its Structure

The system through which educational knowledge is distributed comprises a vast, and for the most part, loosely structured network of communication channels. Certain components, of course, stand out: the commercial market of educational materials with its advertising efforts; trend setters and gatekeepers among publicists and the media; the arena of educational issues and debates in the public domain which include the channels of mass media, magazines, trade books, and the efforts of interest

groups; informal, interpersonal networks among experts and practitioners; organized knowledge availability systems, such as ERIC; the communication channels of professional and scholarly societies, such as meetings, journals, handbooks; especially designed efforts to distribute educational knowledge through deliberately created organized channels, as for example in certain efforts of the regional laboratories, and others.

How can one reasonably expect to describe such a large and varied domain and obtain usable results? In the first place, previous studies have clarified part of the area,[18] and the systematic assessment of the literature for the purpose at hand will be profitable.

Secondly, an overview of the total system, its differentiated conductivity and its tutoring effects, can be sketched by utilizing the knowledge of expert professionals, such as prominent education generalists. Thirdly, a limited scope research program, tracing the structure of the knowledge distribution system from both the input and output side will be necessary. The questions here are:

-- What does the system "deliver" to the practicing educator?

-- How does he scan the domain for knowledge?

-- How is his search behavior affected by the differential conductivity and filtering effects in the system?

On the other side, there arise the issues:

-- What is the role of research and development center inputs into the knowledge distribution system?

Tracer studies from both sides are recommended as a procedure to determine the patterns of differential conductivity in the knowledge distribution system.

4.3 Standards

The dissemination of the standards of professionalism advocated by the research and development movement is one of its desired impacts. However, the explicit conception of educational reform through science and technology competes with several alternatives in the arena of educational change.[19] One would want to know a great deal about the distribution of preferences for what is needed in educational change among the significant actors in the knowledge distribution system. What, for example, are those sectors of the system that have a particular affinity for the research and development approach and its products; are there sectors that have resistances to this approach?

The question of the distribution of standards, then, has two aspects to it. There is the differential distribution of knowledge about and acceptance of the model of educational professionalism described above, and the distribution of basic paradigms for education, that is the images of the child as learner and of what "high quality" education means.

It is reasonable to suppose that the distribution of beliefs about these matters among actors in the knowledge distribution system have been specifically impacted by the Research and Development Center Program. Further, it is likely that the social patterns of acceptance or rejection of standards and paradigms may, in part, account for the differential conductivity of the system when it comes to the distribution of specific devices, techniques and procedures.

In order to tackle this kind of question, it would be highly desirable to identify those persons who are significant gatekeepers in the knowledge distribution system of education, and to investigate their

characteristics, beliefs, and practices by means of a survey. Should there be practical knowledge needs toward the highly specific information to be obtained in this matter, the effort may be justified. However, we recommend an approach of utilizing symposia and group discussions in order to obtain gross estimates of this information at lesser costs. Clearly, some reliable knowledge of the characteristics of knowledge distribution gatekeepers is a key item for planning effective knowledge dissemination efforts. One might expect in this arena certain cohort effects, effects of basic values and attitudes towards political issues.

Some attention must be paid to the distribution of educational knowledge through the training and education of professionals. In this area we would expect to find relationships with the knowledge distribution system in the academic disciplines and in schools of education. The centers themselves have a training impact which is not negligible. Certain key concepts of theirs may well have found their way into graduate and undergraduate curricula in universities. This matter might be seen as closely connected with the manpower aspects of knowledge production and should be investigated in that connection.

4.4 Priorities in Knowledge Demands and Supplies

In analogy to the treatment of priorities in knowledge production, we can ask questions about the respective priority scales of those who have knowledge needs or demands as against those who regulate the supply. What, for example, are the knowledge and information needs of those who distribute educational knowledge? What incentives operate on them (if any) to orient themselves towards the research and development system and its

products? What is the relationship between the priority structure of the knowledge demand, and the offering?

The complex phenomenon of searches for reliable educational knowledge by practitioners, and of the priorities for the information needs they perceive is not well understood. In fact, the success of the Research and Development Program in distributing its output depends largely on its ability to generate a need for the knowledge it supplies in the distribution, implementation and use systems. It would therefore be most interesting to demonstrate what, if any, impact the Research and Development Center Program has had on knowledge demands for the results of educational research and development in schools with direct, indirect, or no formal relations with research and development centers and laboratories, and undertake the same with centrally placed persons or organizations in the knowledge distribution system.

4.5 Designs for Knowledge Distribution

Several approaches to the problem of disseminating educational knowledge have been tried by the centers and laboratories. A summary statement of their experience can be prepared to assess the impact of the effort on the creation of appropriate models for knowledge distribution projects. This is largely an effort to gather and synthesize information by reviewing the experience of such projects, scrutinizing the reports and interviewing personnel.

4.6 Products: Devices, Technologies, Procedures

On the basis of the detailed product list described above (item 3.6), the scope of dissemination and the networks of product distribution need to be described. This enterprise has at least the following aspects:

-- An inventory and description of organized distribution networks, such as the programs constructed in the "Follow-Through" effort, school networks of the laboratories and centers, and the like; a descriptive summary of the accumulated experience based on interviews with key personnel.

-- Selected "tracer" studies of several products from centers to users.

-- Utilization of a survey approach to study the scope of diffusion in the field, as well as the range of knowledge about center products.

4.7 Manpower

Specialized roles have developed in the context of the knowledge distribution system, such as educational consultants, change agents, education editors and the like. The availability of qualified personnel for these responsibilities may have been affected by the efforts of laboratories and centers to disseminate and implement their innovations. This point links with the already identified need to review the impact of the Research and Development Center Program on the supply of educational manpower.

5. THE KNOWLEDGE IMPLEMENTATION SYSTEM

5.1 Major Questions

Innovations which reduce the complexity of the work process and increase the subjective certainty of the workers may find readier adoption and use, other things being equal, than innovations which, in the interest of increased effectiveness or other values, increase complexity and uncertainty.[20] Virtually all the innovations deriving from recent educational research and development appear to be of the latter variety. It is this circumstance which produces special difficulties in implementation of newly developed programs and products. The special role of "program implementor" has developed in some such settings.[21]

The major questions in this area are:

-- What has been the effect of disciplined educational research and development on organizational arrangements, personnel, and policies for program implementation?

-- What conclusions can be drawn from the experience to date?

5.2 Mapping the Domain and its Structure

A first overview of the domain of program implementation can be obtained by working outward from the research and development centers and regional laboratories to identify explicitly organized implementation programs. An inventory of such major implementation efforts may, in fact, be possible on the basis of the perusal of reports available in the NIE. This should be supplemented by interviews with experienced persons.

Several programs and organizations operate in this field. A typology of such organizations and approaches can be constructed, which would provide information important for deciding on a program of case studies. These studies would investigate the relation between implementation efforts and the use system, and the system's varying degrees of implementation capacity. Particularly complex, both successful and unsuccessful, implementation sites may be selected for analysis by the case study method.

5.3 Standards and Priorities

This topic raises the dual issue of standards for the assessment of implemented programs, that is the issue of the degree to which a program is actually being carried out as it is designed, and the question of professional standards for the implementation tasks themselves. "Implementors" even more than knowledge "disseminators" bridge the gap between knowledge and practice. They participate in at least two different normatively regulated domains: the operating system of the school, and the sources of knowledge production and distribution. Priority settings, scheduling of activities, standards of judgment, in both areas are different. A study of these differences and of alternative implementation strategies would be useful.

5.4 Manpower

It seems necessary to determine the characteristics and the supply of qualified educational program implementors. Since the role is in an early phase of institutionalization, it will be difficult to accomplish this with any rigor. However, a possible approach might be to study the

research and development center implementation and school interface personnel, and to determine their background and career lines for a first estimate of the sources for this type of personnel. Again, there is a linkage to other questions concerning the manpower training impact of the research and development centers raised before.

6. THE KNOWLEDGE USE SYSTEM

6.1 Major Questions

What is thought of as the "use system" here are the schools of the nation, all the institutions in which formal education takes place. Clearly, this system of institutions not only uses knowledge produced outside it, but it also generates accumulated pedagogical experience and expertise, knowledge of its own, and educational innovations. Here the major questions concerning the study of the impact of the Research and Development Center Program are:

-- What is the relationship between innovative activities and knowledge production in schools, and the knowledge supply, especially as it is provided by the research and development system?

-- What alternative sources of educational knowledge are being utilized? Which are the major occasions which cause educational practitioners to search for applicable knowledge?

-- What actually happens in such searches?

-- Under what circumstances do they lead towards the Federal Research and Development Center Program?

6.2 Mapping the Domain and its Structure

Here considerations arise which concern essentially the construction of an appropriate sample for the study of educational knowledge utilization in school districts, and in schools. It will be necessary to establish

a sample of both school districts and individual schools for the purpose of investigating knowledge utilization. It must be recognized that this particular investigative purpose must be taken into account in structuring the sample itself. The task therefore will be quite complex in that the obvious criteria of region in the country, size of district, urban or non-urban location, ethnic and socioeconomic composition, and the like, need to be supplemented by major criteria for stratifying the sample in terms of relations to the knowledge production, distribution, and implementation systems. For example, schools and districts known to maintain direct and formal links to the research and development system need to be compared and contrasted with schools having no such ties.

6.3 Standards

Each of our analytically distinct systems, we think, can be described in terms of a prevailing pattern or distribution of standards of professional practice. It certainly would shed considerable light on the field to be impacted by the research and development center system if the social distribution of commitments to different conceptions of appropriate standards for responsible professional conduct were known, as well as the distribution of commitment to basic paradigms in pedagogical orientations.

Earlier we discussed the proposition that one of the most far-reaching impacts of the Research and Development Center Program may well be the propagation of more rigorous standards of professional practice and new paradigms of pedagogy. It is at least likely that changes in pedagogical orientations and conceptions of what is desirable practice have

consequences of wide scope and possibly duration, which may surpass the effects of recently developed technological innovations in the field. In order to understand the mechanisms of such processes, the ways through which standards and paradigms in the teaching profession are shaped need to be clarified. For example, one might study the effects of cohorts, of schools of education, professional experience in the system, and other aspects by tracing them from schools to their source in the context of a large scale survey of schools and school districts.

6.4 Priorities

The relative urgency with which knowledge demands and searches are pressed, or proffered innovations accepted, depends on the concrete constraints and incentives in the operating knowledge use system. At least it is reasonable to look in this direction for determinants. Teachers' priorities for knowledge obviously differ from those of research scientists, as they relate to a different set of professional responsibilities and constraints. Relatively little is known about the priority structure for new educational knowledge among experienced teachers, principals, and other practicing educators. The explicit study of these priority structures from the point of view of the practical constraints shaping them also would be useful knowledge for planning and for counteracting negative ideology formation among research and development personnel, concerning such conceptions as alleged "resistances to innovation" or "prejudices against science."

6.5 Stock of Knowledge

What actually is the stock of pedagogical knowledge now in use in schools of different types? Obviously, some pedagogical theories and methods are in use in all schools; what they are and how the practicing profession maintains its stock of knowledge should be described. The issue is closely connected with our discussion of standards and priorities, but more specifically we are raising the issue of which pedagogical propositions, methods, and practices are known by teachers and other experienced professionals to be reliable. It should not be surprising to find that this practical stock of knowledge differs, maybe sharply, from what the leaders of educational research and development, and professors in schools of education advocate or accept; it is necessary to discover the grounds of knowledge validation in the practicing profession, and the differences between them and the conceptions of reliable evidence among researchers and developers. Such information has obvious relevance to ascertaining the mechanisms through which research and development center products may impact schools. It is likely that this information can be tapped in a large scale survey of school personnel, but it should be supplemented by focused field observations and follow-up studies on the basis of the survey results.

6.6 Technologies, Devices and Procedures

This point concerning the distribution of research and development center technologies and products has been discussed in different contexts. (Items 3.6 and 4.6)

In this connection only the reminder is necessary that the studies of this distribution process must commence from both sides: by tracing the distribution from the center "outward," and by following the network of implementation and distribution from the schools "inward."

6.7 Manpower

Certainly it is not necessary for the purpose of this impact study program to investigate the total manpower supply of American education. However, estimates of the characteristics and sources of school personnel providing those specialized services that make educational research and development results available, would be useful.[22] This item overlaps with the search for the sources and characteristics of manpower in the knowledge distribution and implementation system, but we refer here specifically to school personnel. Impacts on this manpower pool through contacts with the Research and Development Center Program and the laboratories, for example during training, through prior employment, and others, need to be considered.

7. INTERSYSTEM LINKS

7.1 Major Questions

The links between the four systems of knowledge production, distribution, implementation, and use are of particular importance for the purpose of tracing impacts of the knowledge production sector to the other ones. The question of the differential conductivity of the total system will receive a partial clarification from studies of linkages, which also can be thought of as system-system interfaces.

In the empirical investigations, it might turn out that some of the system boundaries are diffuse, so that clearly defined linkages are difficult to locate. It therefore may be tempting to restrict the investigations to deliberately planned linkage or knowledge transfer arrangements. This should, however, not be done to the exclusion of studying "natural," i.e., unplanned system interfaces, and linkages between system sectors that are affected by public media.

The major questions in this area are:

-- What professional roles have developed in these linkage structures?

-- Are there gaps or role confusions?

-- What are the system interfaces, what specialized linkage structures have emerged, and how do they contribute to the conductivity of the total system connecting knowledge production and knowledge use?

7.2 Mapping the Domain and its Structure

The basic information for describing the array of linkage structures and system interfaces can be derived from the analysis of the four major systems of production, distribution, implementation, and use. The differences, for example, in standards, priority, organizational structures, describe the contexts for each of the system linkages.

A special inventory of system interfaces is needed. This inventory would list concrete settings in which linkage structures arise at system interface points. Some such areas are sketched in the following items.

7.3 Knowledge Production-Distribution Links

Arrangements now exist for the distribution of research results to scholarly audiences, through publication and presentation of papers at meetings. One wonders, however, what the impact of these activities is on the priorities and decisions of large publishers of educational materials. An important question is whether the direct distribution of educational materials from the research and development system is more or less effective than indirect effects on the knowledge distribution system. Sources of these indirect effects include the setting or influencing of priorities and of quality standards by those who are knowledge distribution gatekeepers.

In this domain of system linkages there arise a number of crucial legal questions, for example concerning copyright laws. They are connected to the economics of the distribution system and the manner in which decisions in it are made. A separate technical legal review of such normative constraints is necessary in supplement to the impact study program.

Focused efforts to distribute research and development products to organized channels or networks, such as cooperative school networks, deserve particularly close attention, since some of them cut across all four systems and might afford useful sites of investigation.

7.4 Knowledge Distribution-Implementation Links

In this connection the particular requirements of the implementation process for knowledge and other supports come to mind. An illustration of this linkage structure can be found in the Follow-Through network, and the studies conducted to ascertain the degree of implementation of certain programs. The characteristics of "implementors" have been mentioned as an important topic of study in a different connection although little is known in a reliable manner about their interactions with the knowledge distribution and production systems.

7.5 Knowledge Implementation-Use Links

The work of implementing a new program impinges on and is constrained by the use system. There is considerable literature on change agents and innovators in schools,[23] but further work from the point of view of intersystem links is indicated. In particular, the question of long range affects on the use system and the r ification of the intended program in becoming incorporated into the operating system needs to be raised.

7.6 Intersystem Links and the Directional Conductivity of the System

There are, of course, other system links, such as those directly connecting knowledge production and use, but it seems pedantic and unnecessary to list them all here. One point, however, needs to be emphasized about the total system of linkages. We have earlier used the concept of differential conductivity of this system for knowledge production and use, a concept which seems intuitively clear, in that different channels through the system conduct different types of knowledge at different rates and with differentials in resistance and distortion.

We now add the concept of directional conductivity, by which we mean that the flow of information may be very different from knowledge production to use, as against, from the use system to knowledge production. For example, information about priority setting processes and constraints in different systems may become insufficiently available in the knowledge production sector. Further, information about the practical experience with innovations implemented and in use may not be made available to knowledge producers. Therefore, mechanisms for the multi-directional flow of information, especially concerning priorities and knowledge needs, need to be investigated. The Research and Development Center Program itself, by emphasizing the need for product evaluation and evaluative research of long range effects (at least in its intent and program) may have impacted aspects of the multi-directional flow system in education. Clearly, such multi-directional flow affects the capacity of the total system to be adapted and self-corrective. While we hesitate to recommend it, it might be instructive to attempt the construction of a model of the total system, its linkages and channels, in order to represent its differential conductivity characteristics.

8. STUDIES

8.1 Introduction

In this section we outline a program of studies designed to obtain the information demanded by the foregoing reflections. An important consideration is the comprehensive, synthetic nature of the information needs for mapping the system's structure, which contrasts with the need for very fine grained and detailed measures in certain areas, especially in the study of linkages, implementation processes, and certain aspects of the knowledge production system.

Obviously, the greater the precision of measurement, the greater the cost. Since some of the objects to be studied are of great size, the cost for high precision and fine grain measurements throughout the issues raised in the foregoing may be prohibitive. We therefore strive to combine rather coarse measurement methods and procedures for obtaining an overview of both a quantitative and qualitative nature, with selected procedures of "close-up" studies. The program of studies recommended here proceeds in terms of a multi-layered approach and combines historical and sociological methods with procedures of informed reportage.

8.2 An Intellectual History of the R & D Center Movement

As one fundamental aspect of the impact study program, a monograph should be commissioned which describes the background, development, and impact of the research and development center efforts on the field of

educational research, its paradigms, standards, and its intellectual productivity. It is thought that this work may require one year of effort of a senior educational historian with an appropriate staff.

Under item 3.5 (Stock of Knowledge in the Knowledge Production System) above, we suggested the exploration of the feasibility of stimulating a new assessment of the state of knowledge in the field, for example by the National Academy of Education. Such an effort, clearly, would be quite different from the historical study described here. There would, however, be overlaps, as there would be connections between the historical effort and the educational knowledge production study suggested below (see item 8.7). Such partial overlaps are not likely to result in duplication of efforts, but in mutual reinforcement and are thus desirable.

8.3 Review Symposia on Research and Development Policies in Education

Three different review symposia by experts in knowledge distribution, educational research and development scholars, and leading practicing educators respectively are recommended. An assembly of fewer than 25 persons for each topic, carefully selected and prepared by staff papers and a topical checklist, can be used to obtain important qualitative information on many of the items outlined above. Each symposium should be a working session of approximately two days. For example, the first symposium might consist of persons whose task it is to reflect, analyze and then to translate into the popular media trends and emphases in American education. Participants could be selected from five categories: (1) publishing houses, (2) major newspapers, (3) news magazines, (4) literary magazines, (5) other media. Examples of each of these categories might be the

following: A representative of the editorial board from three different kinds of publishing houses, those with strong lists in the area of children's fiction and non-fiction, publishers of college textbooks and publishers of texts for public school use. In addition, one might choose a house with a strong list of tradebooks relating to education.

Obvious newspaper staffs to be represented in the person of their education editor might be the New York Times, the Washington Post, the Christian Science Monitor, the Wall Street Journal and the like. News magazines might include Time, Newsweek, U.S. News and World Report, also the special Sunday editors of the New York Times Magazine section and others. "Literary" magazines might include Saturday Review-World, Harper's, Psychology Today, Ramparts, Atlantic Monthly. Finally one might think of television editors of teacher materials, including education editors on the major networks.

We might begin by discussing the effectiveness of several policies and programs, and of especially research and development efforts. More specific items can be selected from the outline suggested by the structure and analysis of this design paper which might serve as a guide towards structuring the effort..

In subsequent symposia leading educational research and development scholars, including representatives of the research and development program and of non-profit organizations, might address themselves to a similar set of questions and offer estimates of scope and nature of the R & D center impact. Finally, leading practicing educators, in a separate session, might be asked to assess the same domain.

It is essential, of course, that each symposium be prepared by careful selection of participants, draft papers, and materials, and that competent staff be present to prepare a summary of observations and conclusions as a final report on each symposium. We feel that the procedure is very likely to yield important inputs into the design of studies to be carried on subsequently.

8.4 Overview Papers

It is suggested that for the domains of knowledge distribution, implementation, and use separate overview papers be prepared. These papers are to draw on available documentation in the NIE, formal and informal interviews, and published materials. The procedure envisioned is similar to that used by Francis S. Chase.[24] It is thought that each of these papers might require a half-year effort on the part of an experienced person. The materials should become background for the design of more specific studies.

8.5 Designs and Design Review Conference of Cooperating Investigators

In order to achieve a reasonably integrated impact study program, it seems desirable to commit designs for the component studies at an early date and organize a design review conference in which all cooperating investigators participate. The objective of this conference is to review the plans for the research program, to utilize the result of the symposia and the overview papers, to receive a preliminary report on the progress of the historical work, and to arrive at specific decisions about special emphases and procedures in the research to be undertaken.

This step may appear unusual, but given the fact of the large scope of the enterprise and the need to achieve efficient coordination of efforts, it is thought advisable to proceed in this fashion.

8.6 School and School Districts Survey and Field Studies of Knowledge Utilization

This large-scale project in the format of a major sample survey would be designed to investigate the topics outlined under section 6 in this paper (The Use System) and to provide linkages to the focused network studies and the case study program mentioned below. Capability should be provided for follow-up field work after the completion of the survey. Special emphasis might be made on acquaintance with research and development knowledge, its use, the nature of knowledge demands and priorities in different school systems, knowledge search behavior, and the credibility of knowledge sources.

One desired result would be the construction of indicators suitable for subsequent monitoring of the system. This must be thought of as a large effort which will require substantial resources.

8.7 Educational Knowledge Production Study

This is a recommendation for a sociology of science investigation of the items considered in section 3 of this paper (The Knowledge Production System). It must include trends in organizational patterns, standards, priorities, scope and nature of scientific production, networks of cooperation and citation, and manpower development. Comparison with

the state of affairs prior to the R & D center system is possible, for example through reference to the work of Sam Sieber and associates.[25]

This is a large scale effort which it might take one and a half years to complete.

8.8 Focused Network Studies

These are studies involving the detailed tracing of selected products through the network of contacts, commencing both from the centers outward and from the schools inward. They should involve attention to possible differences in patterns between early adopters and late adopters of the products chosen. Tracing the networks in complete detail is a cumbersome process; it therefore should only be undertaken with regard to selected products and their distribution. This effort should be linked both to the school survey and the knowledge production study. It will be necessary to estimate the most appropriate sequencing of these studies as a part of their design.

8.9 Selected Linkage Case Studies

Case studies are an appropriate device for investigating linkage arrangements. Several themes for such case studies have been suggested in section 7 of this paper (Intersystem Links). It would be desirable to construct a scheme outlining the domain so that different case studies can be more systematically evaluated with regard to the information yield for understanding the system.

8.10 Manpower Impact Studies

Throughout this paper emphasis has been given to the assessment of the impact of the Research and Development Center Program on manpower for knowledge production, distribution, and implementation specifically. The study of representative career patterns of educational personnel having been in contact with research and development center or laboratory work at one stage in their career, as well as studies of the characteristics and recruitment fields of personnel now working in the distribution and implementation systems are useful in this regard.

8.11 Symposium of Principal Investigators: Knowledge Production and Use in American Education

In analogy to the design conference proposed for the initial phases of this research program, it is suggested that it be concluded by a symposium in which research reports are presented, discussed, and an integrated interpretation is attempted by the group of cooperating investigators. The recommendation is made because this procedure may facilitate the practical use of the knowledge gained.

8.12 Construction of a Monitoring System of Educational Knowledge Production and Use

The continuous observation or monitoring of a complex cultural institution is difficult at best and, if badly done, can have negative effects. Using such considerations such as the ones set out in this paper, a design for monitoring the system should be established simultaneous with but separate from the design for this impact study program.

However, the monitoring measures should not be implemented until the results of the study proposed here are available so that the experience gathered with this comprehensive investigation can be utilized for the improvement of the monitoring system. For example, both the school survey and the knowledge production study may yield proposals for repeatable measurements. Similarly, the method of conducting symposia from time to time may be a good device to supplement quantitative measures with qualitative insights. It is therefore suggested that an evaluation of the resulting research reports be conducted for the purpose of validating the design of the monitoring system.

Conclusions

We have in this paper outlined a framework for a program of study through which the impact of the research and development center system on American education can be assessed. We have chosen a rather comprehensive, systemic approach, designed to elucidate the position of the Research and Development Centers in the total knowledge production, distribution, implementation and use network. We believe that a comprehensive view of this kind, supplemented by specifically focused studies in critical areas, is necessary for a realistic assessment of the policy. It should be remembered that we are dealing here with a combination of governmental science and educational policy, designed to impact a major domain of American culture. No simple measures of cost effectiveness or quantity of productivity are a convincing substitute to the approach we propose.

As a final note, we do wish to point out that the Federal policy under scrutiny and the concentrations in research and development it has produced are in many ways peculiarly American. Other countries, having different educational philosophies and systems, have proceeded rather differently, even though several of them have, under the stimulus of the American example, established somewhat similar institutions. It might be useful for policy makers to avail themselves of the advice of perceptive foreign scholars and educators, possibly by requesting them to offer critical reviews of the complex of reports and studies which might be the result of this effort.

Footnotes

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16. For a discussion of paradigm shifts, see for example Thomas S. Kuhn, The Structure of Scientific Revolutions, 2nd edition, Vol. II, No. 12, University of Chicago Press, 1970.

17. The Comptroller General of the U.S., Report to the Congress, "Educational Laboratory and Research and Development Center Programs Need to be Strengthened," National Institute of Education, Department of Health, Education and Welfare, 1973.

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